PRELIMINARY

DRAINAGE REPORT

for

Pennington Industrial

SITE LOCATED

SOUTH CORNER OF MINTHORN AND CHANEY STREETS
CITY OF LAKE ELSINORE
COUNTY OF RIVERSIDE
STATE OF CALIFORNIA

APN: 377-160-014

Prepared for:

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May 17, 2019

REGISTERED PROFESSIONAL ENGINEER
BRADLEY C. KNEPP
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CIVIL
STATE OF CALIFORNIA

Table of Contents

Attachments

Jurisdiction and Scope of Drainage Report

Stormwater impacts associated with the Pennington Industrial project are within the jurisdiction of the City of Lake Elsinore. The City requires that hydrologic analyses be performed according to methodologies prescribed by the Riverside County Flood Control and Water Conservation District (RCFC).

The scope of this preliminary report relates to potential storm water impacts associated with development of the project site and quantifies the existing and proposed 10- and 100-year 1-hour peak flow rates generated from the site using RCFC Rational Method. The City requires the post-development increased runoff volume for the greater of the 10-year 6- or 24-hour events be detained onsite. Preliminary calculations for these volumes were calculated using RCFC approved TR-55 method.

Project Description, Analysis and Conclusion

The project is located at the (plan) southeast corner of Minthorn and Chaney Streets in the City of Lake Elsinore. It is bounded by Minthorn to the (plan) north, Chaney to the west, a public school to the south, and a County social services facility to the east.

Please reference the **Existing Drainage Map**, attached. Immediately north of the site, runoff in Minthorn Street flows (plan) west, joins with flows heading south, from one block upstream in Chaney Street, and continues south down Chaney Street. From an onsite highpoint at the Minthorn Street right-of-way, approximately 43% of the existing site drains south and discharges from the site into a concrete inlet on the adjoining County social services property. The remainder of the project site discharges into Chaney Street all along the northwest property line. All flows from the site ultimately discharge into Temescal Creek. The peak 100-year 1-hour flow from the existing site is 11.4 cubic feet per second (cfs). The existing runoff volume for the 10-year 6- and 24-hour events are 14,106 cubic feet (cf) and 47,750 cf, respectively.

Please reference the **Proposed Drainage Map**, attached. It is not clear if this site has always drained in the way it does now, as historical photos indicate several agricultural and/or commercial grading operations have occurred on the site over the past 80 years. For this reason, and because the project proponent does not want to create a stormwater discharge agreement with the adjoining property owner, the existing inlet will be blocked off at the property line and all proposed site flows will discharge to Chaney Street and ultimately into Temescal Creek. The peak 100-year 1-hour flow from the preliminary proposed site is 15.5 cfs. The post-developed runoff volume for the 10-year 6- and 24-hour events are 20,731 cf and 57,903 cf, respectively.

The required mitigation **Detention Volume** for the site is the post-developed runoff volume minus the existing runoff volume for the 10-year 24-hour event, or 10,153 cf. This volume will be detained in a waterproof storm drain system consisting of a bay of 24-inch diameter high density polyethylene (HDPE) storm drain and outlet via a 6-foot wide parkway (under-sidewalk) drain (designed for the peak 100-year flow) into Chaney Street from the west corner of the project site. Lower flows will pass through a water quality treatment device. After a storm is over, the full volume detained will also slowly drain to the street via the same water quality treatment device at the water quality flow rate (approximately 0.6 cfs max). Please see the project WQMP for further information on stormwater quality requirements.

We conclude there are no anticipated adverse impacts to existing storm drain facilities associated with development of this project site.

APPENDIX

A

RIVERSIDE COUNTY RATIONAL METHOD HYDROLOGY

EXISTING AND PROPOSED 10- AND 100-YEAR CALCULATIONS

NRCS SOILS REPORT WITH CURRENT HYDROLOGIC SOIL GROUP DATA

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          Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
     Rational Hydrology Study        Date: 02/27/19  File:74422Q10DA1.out
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74422
Pennington Industrial Park
Rational Method Hydrology
Existing 10-year 1-hour Event DA 1

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------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

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Program License Serial Number 6241

------------------------------------------------------------------------
Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =   10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [ Elsinore-Wildomar ] area used.
10 year storm 10 minute intensity =  2.320(In/Hr)
10 year storm 60 minute intensity =  0.980(In/Hr)
100 year storm 10 minute intensity =  3.540(In/Hr)
100 year storm 60 minute intensity =  1.500(In/Hr)

Storm event year =  10.0
Calculated rainfall intensity data:
1 hour intensity =  0.980(In/Hr)
Slope of intensity duration curve = 0.4800




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Process from Point/Station        1.000 to Point/Station        2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =    546.000(Ft.)
Top (of initial area) elevation =  1278.500(Ft.)
Bottom (of initial area) elevation =  1269.500(Ft.)
Difference in elevation =     9.000(Ft.)
Slope =    0.01648  s(percent)=       1.65
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   14.988 min.
Rainfall intensity =      1.907(In/Hr) for a    10.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.752
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  78.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      3.871(CFS)
Total initial stream area =       2.700(Ac.)
Pervious area fraction = 1.000
End of computations, total study area =           2.70 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged RI index number =  78.0
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          Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
     Rational Hydrology Study        Date: 02/27/19  File:74422Q10DA2.out
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74422
Pennington Industrial Park
Rational Method Hydrology
Existing 10-year 1-hour Event DA 2

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------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

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Program License Serial Number 6241

------------------------------------------------------------------------
Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =   10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [ Elsinore-Wildomar ] area used.
10 year storm 10 minute intensity =  2.320(In/Hr)
10 year storm 60 minute intensity =  0.980(In/Hr)
100 year storm 10 minute intensity =  3.540(In/Hr)
100 year storm 60 minute intensity =  1.500(In/Hr)

Storm event year =  10.0
Calculated rainfall intensity data:
1 hour intensity =  0.980(In/Hr)
Slope of intensity duration curve = 0.4800




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Process from Point/Station       11.000 to Point/Station       12.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   411.000(Ft.)
Top (of initial area) elevation =  1278.500(Ft.)
Bottom (of initial area) elevation =  1273.000(Ft.)
Difference in elevation =     5.500(Ft.)
Slope =    0.01338  s(percent)=       1.34
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   13.948 min.
Rainfall intensity =      1.974(In/Hr) for a    10.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.756
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  78.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      3.134(CFS)
Total initial stream area =        2.100(Ac.)
Pervious area fraction = 1.000
End of computations, total study area =           2.10 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged RI index number =  78.0
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          Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
     Rational Hydrology Study        Date: 02/01/19  File:74422Q100A.out
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74422
Pennington Industrial Park
Rational Method Hydrology
Existing 100-year 1-hour Event DA 1

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------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

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Program License Serial Number 6241

------------------------------------------------------------------------
Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =  100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [ Elsinore-Wildomar ] area used.
10 year storm 10 minute intensity =  2.320(In/Hr)
10 year storm 60 minute intensity =  0.980(In/Hr)
100 year storm 10 minute intensity =  3.540(In/Hr)
100 year storm 60 minute intensity =  1.500(In/Hr)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity =  1.500(In/Hr)
Slope of intensity duration curve = 0.4800




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Process from Point/Station        1.000 to Point/Station        2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =    546.000(Ft.)
Top (of initial area) elevation =  1278.500(Ft.)
Bottom (of initial area) elevation =  1269.500(Ft.)
Difference in elevation =     9.000(Ft.)
Slope =    0.01648  s(percent)=       1.65
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   14.988 min.
Rainfall intensity =      2.919(In/Hr) for a   100.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.797
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  78.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      6.284(CFS)
Total initial stream area =        2.700(Ac.)
Pervious area fraction = 1.000
End of computations, total study area =            2.70 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged RI index number =  78.0
```

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         Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
     Rational Hydrology Study        Date: 02/01/19  File:74422Q100.out
------------------------------------------------------------------------
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74422
Pennington Industrial Park
Rational Method Hydrology
Existing 100-year 1-hour Event DA 2

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------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

------------------------------------------------------------------------


Program License Serial Number 6241

------------------------------------------------------------------------
Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =  100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [ Elsinore-Wildomar ] area used.
10 year storm 10 minute intensity =  2.320(In/Hr)
10 year storm 60 minute intensity =  0.980(In/Hr)
100 year storm 10 minute intensity =  3.540(In/Hr)
100 year storm 60 minute intensity =  1.500(In/Hr)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity =  1.500(In/Hr)
Slope of intensity duration curve = 0.4800




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Process from Point/Station        11.000 to Point/Station        12.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   411.000(Ft.)
Top (of initial area) elevation =  1278.500(Ft.)
Bottom (of initial area) elevation =  1273.000(Ft.)
Difference in elevation =     5.500(Ft.)
Slope =    0.01338  s(percent)=       1.34
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   13.948 min.
Rainfall intensity =      3.022(In/Hr) for a   100.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.800
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  78.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      5.079(CFS)
Total initial stream area =       2.100(Ac.)
Pervious area fraction = 1.000
End of computations, total study area =           2.10 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged RI index number =  78.0
```

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
Rational Hydrology Study Date: 05/15/19 File:74422rmP10.out

74422
Pennington Industrial
Rational Method Hydrology
Proposed 10-year 1-hour Storm Event

********* Hydrology Study Control Information **********

English (in-lb) Units used in input data file

Program License Serial Number 6241

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [Elsinore-Wildomar] area used.
10 year storm 10 minute intensity = 2.320(In/Hr)
10 year storm 60 minute intensity = 0.980(In/Hr)
100 year storm 10 minute intensity = 3.540(In/Hr)
100 year storm 60 minute intensity = 1.500(In/Hr)

Storm event year = 10.0
Calculated rainfall intensity data:
1 hour intensity = 0.980(In/Hr)
Slope of intensity duration curve = 0.4800

++
Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 393.000(Ft.)
Top (of initial area) elevation = 74.850(Ft.)
Bottom (of initial area) elevation = 71.100(Ft.)
Difference in elevation = 3.750(Ft.)
Slope = 0.00954 s(percent)= 0.95

TC = k(0.336)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 9.293 min.
Rainfall intensity = 2.399(In/Hr) for a 10.0 year storm
MOBILE HOME PARK subarea type
Runoff Coefficient = 0.832
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.250; Impervious fraction = 0.750
Initial subarea runoff = 0.381(CFS)
Total initial stream area = 0.191(Ac.)
Pervious area fraction = 0.250

++
Process from Point/Station 11.000 to Point/Station 99.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.873
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Time of concentration = 9.29 min.
Rainfall intensity = 2.399(In/Hr) for a 10.0 year storm
Subarea runoff = 4.626(CFS) for 2.210(Ac.)
Total runoff = 5.007(CFS) Total area = 2.401(Ac.)

++
Process from Point/Station 12.000 to Point/Station 99.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.873
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Time of concentration = 9.29 min.
Rainfall intensity = 2.399(In/Hr) for a 10.0 year storm
Subarea runoff = 2.052(CFS) for 0.980(Ac.)
Total runoff = 7.059(CFS) Total area = 3.381(Ac.)

++
Process from Point/Station 13.000 to Point/Station 99.000
**** SUBAREA FLOW ADDITION ****

```
COMMERCIAL subarea type
Runoff Coefficient = 0.873
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Time of concentration =     9.29 min.
Rainfall intensity =      2.399(In/Hr) for a    10.0 year storm
Subarea runoff =      2.449(CFS) for      1.170(Ac.)
Total runoff =      9.508(CFS)     Total area =       4.551(Ac.)


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Process from Point/Station       14.000 to Point/Station       99.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.873
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Time of concentration =     9.29 min.
Rainfall intensity =      2.399(In/Hr) for a    10.0 year storm
Subarea runoff =      0.494(CFS) for      0.236(Ac.)
Total runoff =     10.002(CFS)     Total area =       4.787(Ac.)
End of computations, total study area =           4.79 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.106
Area averaged RI index number =  56.0
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        Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
     Rational Hydrology Study        Date: 05/15/19  File:74422rmP100.out
------------------------------------------------------------------------
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74422
Pennington Industrial
Rational Method Hydrology
Proposed 100-year 1-hour Storm Event

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------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

------------------------------------------------------------------------


Program License Serial Number 6241

------------------------------------------------------------------------
Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =  100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [ Elsinore-Wildomar ] area used.
10 year storm 10 minute intensity =  2.320(In/Hr)
10 year storm 60 minute intensity =  0.980(In/Hr)
100 year storm 10 minute intensity =  3.540(In/Hr)
100 year storm 60 minute intensity =  1.500(In/Hr)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity =  1.500(In/Hr)
Slope of intensity duration curve = 0.4800


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station        2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   393.000(Ft.)
Top (of initial area) elevation =    74.850(Ft.)
Bottom (of initial area) elevation =    71.100(Ft.)
Difference in elevation =     3.750(Ft.)
Slope =    0.00954  s(percent)=       0.95
```



```
TC = k(0.336)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.293 min.
Rainfall intensity =      3.672(In/Hr) for a   100.0 year storm
MOBILE HOME PARK subarea type
Runoff Coefficient = 0.850
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.250; Impervious fraction =  0.750
Initial subarea runoff =      0.596(CFS)
Total initial stream area =       0.191(Ac.)
Pervious area fraction = 0.250


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station      99.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Runoff Coefficient = 0.880
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Time of concentration =     9.29 min.
Rainfall intensity =      3.672(In/Hr) for a   100.0 year storm
Subarea runoff =      7.141(CFS) for      2.210(Ac.)
Total runoff =      7.737(CFS)     Total area =       2.401(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station      99.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
COMMERCIAL subarea type
Runoff Coefficient = 0.880
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Time of concentration =     9.29 min.
Rainfall intensity =      3.672(In/Hr) for a   100.0 year storm
Subarea runoff =      3.167(CFS) for      0.980(Ac.)
Total runoff =     10.904(CFS)     Total area =       3.381(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station      99.000
**** SUBAREA FLOW ADDITION ****
```

```
COMMERCIAL subarea type
Runoff Coefficient = 0.880
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Time of concentration =     9.29 min.
Rainfall intensity =      3.672(In/Hr) for a   100.0 year storm
Subarea runoff =      3.781(CFS) for      1.170(Ac.)
Total runoff =     14.685(CFS)     Total area =       4.551(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       99.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.880
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Time of concentration =     9.29 min.
Rainfall intensity =      3.672(In/Hr) for a   100.0 year storm
Subarea runoff =      0.763(CFS) for      0.236(Ac.)
Total runoff =     15.447(CFS)     Total area =       4.787(Ac.)
End of computations, total study area =           4.79 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.106
Area averaged RI index number =  56.0
```

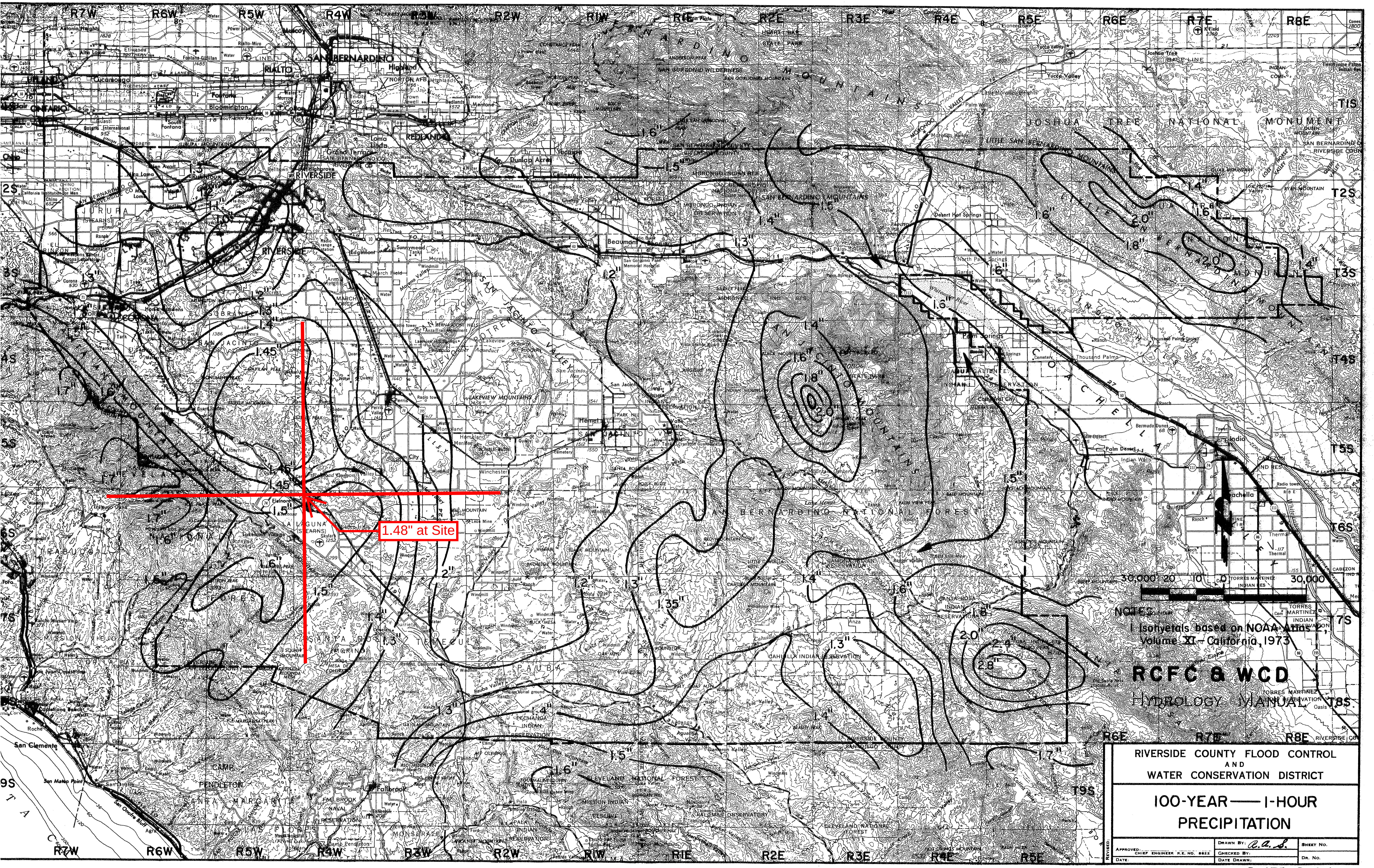
1.48" at Site
NOTES
1. Isohyetals based on NOAA Atlas Volume XI - California, 1973
RCFC & WCD
HYDROLOGY MANUAL
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
100-YEAR — 1-HOUR PRECIPITATION
JOSHUA TREE NATIONAL MONUMENT
SAN BERNARDINO MOUNTAINS
SAN JACINTO MOUNTAINS
SAN BERNARDINO NATIONAL FOREST
CLEVELAND NATIONAL FOREST

PLATE D-4.4

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Western Riverside Area, California

Pennington Industrial

January 8, 2019

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:1,620 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 20, 40, 80, 120

Feet: 0, 50, 100, 200, 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Western Riverside Area, California
Survey Area Data: Version 11, Sep 12, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Feb 24, 2015—Feb 26, 2015

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
GaA	Garretson very fine sandy loam, 0 to 2 percent slopes	3.3	71.1%
GdC	Garretson gravelly very fine sandy loam, 2 to 8 percent slopes	1.3	28.9%
Totals for Area of Interest		**4.6**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Western Riverside Area, California

GaA—Garretson very fine sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hcv1
Mean annual precipitation: 12 to 25 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 220 to 280 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Garretson and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Garretson

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from metasedimentary rock

Typical profile

H1 - 0 to 10 inches: very fine sandy loam
H2 - 10 to 60 inches: loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: B
Ecological site: LOAMY (1975) (R019XD029CA)
Hydric soil rating: No

Minor Components

Arbuckle

Percent of map unit: 5 percent
Hydric soil rating: No

Perkins

Percent of map unit: 5 percent

Hydric soil rating: No

Cortina

Percent of map unit: 5 percent
Hydric soil rating: No

GdC—Garretson gravelly very fine sandy loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: hcv5
Elevation: 50 to 3,000 feet
Mean annual precipitation: 12 to 25 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 250 to 350 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Garretson and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Garretson

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from metasedimentary rock

Typical profile

H1 - 0 to 10 inches: gravelly very fine sandy loam
H2 - 10 to 53 inches: gravelly loam
H3 - 53 to 72 inches: loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.4 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B

Ecological site: LOAMY (1975) (R019XD029CA)
Hydric soil rating: No

Minor Components

Cortina

Percent of map unit: 5 percent
Hydric soil rating: No

Arbuckle

Percent of map unit: 5 percent
Hydric soil rating: No

Perkins

Percent of map unit: 5 percent
Hydric soil rating: No

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APPENDIX

B

CITY OF LAKE ELSINORE DETENTION CALCULATIONS

DETENTION VOLUME CALCULATIONS FOR 10-YR 6- AND 24-HOUR EVENTS USING NRCS TR-55

SB&O INC.
PLANNING ENGINEERING SURVEYING

Job No: 74422
By: BCK
Date: 2-25-2019
Sheet: 1 of 1

NRCS TR-55 method is utilized below (TR-55 approved per RC), attached.
City requires greater of 10-yr 6- or 24-hr event mitigation (post - pre) volume analysis.
Precipitation depths from 10-yr 6- & 24-hr events per NOAA at project site location, attached.
Existing site imperviousness is 0.00%. Existing site cover is Barren/graded per RCFC and Falow/Bare per TR-55.
Proposed site cover is Commercial per RCFC and Commercial per TR-55.
Hydrologic Soil Group (HSG) per NRCS Soils Report, attached.
Runoff Index (Curve) Nos. are most conservative of: 1) Plates D-5.5 & D-5.6 of *RCFC Hydro Mnl &* 2) Tables 2-2a & 2-2c of *TR-55,* pp. 2-5 & 2-6.
Runoff volume = runoff depth, Q, in inches (per Eq. 2-3 of *TR-55,* p. 2-1), multiplied by Site Area (A).
After precip stops, detention bay will fully drain via the onsite water quality modular wetlands device at Qbmp (~0.6 cfs max).

City Detention (10x6/10x24) Calcs to Determine Detention Volume for Site Property

Storm Event	Precip Depth (in)	(A) Site Area (sf)	Site Area (ac)	(E) Whole Site NRCS Hydro-logic Soil Group	(F) Whole Site Ex Cond. Runoff Index Curve No.	(G) Whole Site Prop Cond. Runoff Index Curve No.	(H) Whole Site Exist Cond. Storm Event Runoff Volume (cf)	(I) Whole Site Prop Cond. Storm Event Runoff Volume (cf)	(K) Mitigation Volume [(I)-(H)] (cf)	(L) Detention Volume Required is Greatest of (K) (cf)
10-yr 6-hr	**1.95**	**208,639**	**4.79**	**B**	**86**	**92**	**14,106**	**20,731**	**6,624**	**10,153**
10-yr 24-hr	**4.22**	**208,639**	**4.79**	**B**	**86**	**92**	**47,750**	**57,903**	**10,153**	
100-yr 24-hr	6.69	208,639	4.79	B	86	92	88,117	99,954	11,837	(100-yr ref. only)

SCS runoff curve number method

The SCS Runoff Curve Number (CN) method is described in detail in NEH-4 (SCS 1985). The SCS runoff equation is

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S} \qquad \text{[eq. 2-1]}$$

where

Q = runoff (in)
P = rainfall (in)
S = potential maximum retention after runoff begins (in) and
I_a = initial abstraction (in)

Initial abstraction (I_a) is all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration. I_a is highly variable but generally is correlated with soil and cover parameters. Through studies of many small agricultural watersheds, I_a was found to be approximated by the following empirical equation:

$$I_a = 0.2S \qquad \text{[eq. 2-2]}$$

By removing I_a as an independent parameter, this approximation allows use of a combination of S and P to produce a unique runoff amount. Substituting equation 2-2 into equation 2-1 gives:

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)} \qquad \text{[eq. 2-3]}$$

S is related to the soil and cover conditions of the watershed through the CN. CN has a range of 0 to 100, and S is related to CN by:

$$S = \frac{1000}{CN} - 10 \qquad \text{[eq. 2-4]}$$

Figure 2-1 and table 2-1 solve equations 2-3 and 2-4 for a range of CN's and rainfall.

Factors considered in determining runoff curve numbers

The major factors that determine CN are the hydrologic soil group (HSG), cover type, treatment, hydrologic condition, and antecedent runoff condition (ARC). Another factor considered is whether impervious areas outlet directly to the drainage system (connected) or whether the flow spreads over pervious areas before entering the drainage system (unconnected). Figure 2-2 is provided to aid in selecting the appropriate figure or table for determining curve numbers.

CN's in table 2-2 (*a* to *d*) represent average antecedent runoff condition for urban, cultivated agricultural, other agricultural, and arid and semiarid rangeland uses. Table 2-2 assumes impervious areas are directly connected. The following sections explain how to determine CN's and how to modify them for urban conditions.

Hydrologic soil groups

Infiltration rates of soils vary widely and are affected by subsurface permeability as well as surface intake rates. Soils are classified into four HSG's (A, B, C, and D) according to their minimum infiltration rate, which is obtained for bare soil after prolonged wetting. Appendix A defines the four groups and provides a list of most of the soils in the United States and their group classification. The soils in the area of interest may be identified from a soil survey report, which can be obtained from local SCS offices or soil and water conservation district offices.

Most urban areas are only partially covered by impervious surfaces: the soil remains an important factor in runoff estimates. Urbanization has a greater effect on runoff in watersheds with soils having high infiltration rates (sands and gravels) than in watersheds predominantly of silts and clays, which generally have low infiltration rates.

Any disturbance of a soil profile can significantly change its infiltration characteristics. With urbanization, native soil profiles may be mixed or removed or fill material from other areas may be introduced. Therefore, a method based on soil texture is given in appendix A for determining the HSG classification for disturbed soils.

Table 2-2a Runoff curve numbers for urban areas [1]

Cover description: Cover type and hydrologic condition	Average percent impervious area [2]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

1 Average runoff condition, and $I_a = 0.2S$.
2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2b Runoff curve numbers for cultivated agricultural lands [1]

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment [2]	Hydrologic condition [3]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T+ CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

1 Average runoff condition, and I_a=0.2S
2 Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.
3 Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

Table 2-2c Runoff curve numbers for other agricultural lands [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2/]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3/]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4/]	48	65	73
Woods—grass combination (orchard or tree farm). [5/]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6/]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4/]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

1 Average runoff condition, and $I_a = 0.2S$.
2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.
3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.
4 Actual curve number is less than 30; use CN = 30 for runoff computations.
5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.
6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Table 2-2d Runoff curve numbers for arid and semiarid rangelands [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition [2/]	A [3/]	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

1 Average runoff condition, and I_a, = 0.2S. For range in humid regions, use table 2-2c.
2 Poor: <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: > 70% ground cover.
3 Curve numbers for group A have been developed only for desert shrub.

RUNOFF INDEX NUMBERS OF HYDROLOGIC SOIL-COVER COMPLEXES FOR PERVIOUS AREAS-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
NATURAL COVERS -					
Barren (Rockland, eroded and graded land)		78	86	91	93
Chaparrel, Broadleaf (Manzonita, ceanothus and scrub oak)	Poor	53	70	80	85
	Fair	40	63	75	81
	Good	31	57	71	78
Chaparrel, Narrowleaf (Chamise and redshank)	Poor	71	82	88	91
	Fair	55	72	81	86
Grass, Annual or Perennial	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Meadows or Cienegas (Areas with seasonally high water table, principal vegetation is sod forming grass)	Poor	63	77	85	88
	Fair	51	70	80	84
	Good	30	58	72	78
Open Brush (Soft wood shrubs - buckwheat, sage, etc.)	Poor	62	76	84	88
	Fair	46	66	77	83
	Good	41	63	75	81
Woodland (Coniferous or broadleaf trees predominate. Canopy density is at least 50 percent)	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	28	55	70	77
Woodland, Grass (Coniferous or broadleaf trees with canopy density from 20 to 50 percent)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
URBAN COVERS -					
Residential or Commercial Landscaping (Lawn, shrubs, etc.)	Good	32	56	69	75
Turf (Irrigated and mowed grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
AGRICULTURAL COVERS -					
Fallow (Land plowed but not tilled or seeded)		76	85	90	92

RUNOFF INDEX NUMBERS FOR PERVIOUS AREA

RUNOFF INDEX NUMBERS OF HYDROLOGIC SOIL-COVER COMPLEXES FOR PERVIOUS AREAS-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
AGRICULTURAL COVERS (cont.) -					
Legumes, Close Seeded (Alfalfa, sweetclover, timothy, etc.)	Poor	66	77	85	89
	Good	58	72	81	85
Orchards, Deciduous (Apples, apricots, pears, walnuts, etc.)		See Note 4			
Orchards, Evergreen (Citrus, avocados, etc.)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
Pasture, Dryland (Annual grasses)	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Pasture, Irrigated (Legumes and perennial grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
Row Crops (Field crops - tomatoes, sugar beets, etc.)	Poor	72	81	88	91
	Good	67	78	85	89
Small Grain (Wheat, oats, barley, etc.)	Poor	65	76	84	88
	Good	63	75	83	87
Vineyard		See Note 4			

Notes:

1. All runoff index (RI) numbers are for Antecedent Moisture Condition (AMC) II.

2. Quality of cover definitions:
   Poor-Heavily grazed or regularly burned areas. Less than 50 percent of the ground surface is protected by plant cover or brush and tree canopy.
   Fair-Moderate cover with 50 percent to 75 percent of the ground surface protected.
   Good-Heavy or dense cover with more than 75 percent of the ground surface protected.

3. See Plate C-2 for a detailed description of cover types.

4. Use runoff index numbers based on ground cover type. See discussion under "Cover Type Descriptions" on Plate C-2.

5. Reference Bibliography item 17.

RCFC & WCD
HYDROLOGY MANUAL

RUNOFF INDEX NUMBERS FOR PERVIOUS AREA

ACTUAL IMPERVIOUS COVER

Land Use (1)	Range-Percent	Recommended Value For Average Conditions-Percent(2)
Natural or Agriculture	0 - 10	0
Single Family Residential: (3)		
40,000 S. F. (1 Acre) Lots	10 - 25	20
20,000 S. F. (½ Acre) Lots	30 - 45	40
7,200 - 10,000 S. F. Lots	45 - 55	50
Multiple Family Residential:		
Condominiums	45 - 70	65
Apartments	65 - 90	80
Mobile Home Park	60 - 85	75
Commercial, Downtown Business or Industrial	80 -100	90

Notes:

1. Land use should be based on ultimate development of the watershed. Long range master plans for the County and incorporated cities should be reviewed to insure reasonable land use assumptions.

2. Recommended values are based on average conditions which may not apply to a particular study area. The percentage impervious may vary greatly even on comparable sized lots due to differences in dwelling size, improvements, etc. Landscape practices should also be considered as it is common in some areas to use ornamental gravels underlain by impervious plastic materials in place of lawns and shrubs. A field investigation of a study area should always be made, and a review of aerial photos, where available may assist in estimating the percentage of impervious cover in developed areas.

3. For typical horse ranch subdivisions increase impervious area 5 percent over the values recommended in the table above.

IMPERVIOUS COVER FOR DEVELOPED AREAS


Pennington
Industrial
Google Earth
N
500 ft

NOAA Atlas 14, Volume 6, Version 2
Location name: Lake Elsinore, California, USA*
Latitude: 33.6833°, Longitude: -117.3344°
Elevation: 1277.2 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.081 (0.068-0.098)	0.110 (0.092-0.133)	0.149 (0.124-0.180)	0.182 (0.150-0.222)	0.228 (0.182-0.288)	0.264 (0.206-0.341)	0.302 (0.230-0.401)	0.342 (0.253-0.467)	0.398 (0.281-0.568)	0.443 (0.302-0.656)
10-min	0.116 (0.097-0.140)	0.158 (0.132-0.190)	0.214 (0.178-0.259)	0.261 (0.216-0.318)	0.326 (0.261-0.413)	0.378 (0.296-0.489)	0.433 (0.329-0.574)	0.490 (0.362-0.670)	0.570 (0.403-0.814)	0.634 (0.433-0.940)
15-min	0.141 (0.118-0.169)	0.191 (0.160-0.230)	0.258 (0.216-0.313)	0.315 (0.261-0.385)	0.395 (0.315-0.499)	0.458 (0.357-0.592)	0.523 (0.398-0.694)	0.593 (0.438-0.810)	0.690 (0.488-0.985)	0.767 (0.523-1.14)
30-min	0.217 (0.182-0.262)	0.295 (0.247-0.355)	0.399 (0.333-0.483)	0.487 (0.403-0.594)	0.609 (0.487-0.771)	0.707 (0.552-0.914)	0.808 (0.615-1.07)	0.915 (0.676-1.25)	1.07 (0.753-1.52)	1.19 (0.808-1.76)
60-min	0.349 (0.292-0.420)	0.473 (0.396-0.571)	0.641 (0.535-0.775)	0.781 (0.646-0.954)	0.978 (0.781-1.24)	1.13 (0.886-1.47)	1.30 (0.987-1.72)	1.47 (1.09-2.01)	1.71 (1.21-2.44)	1.90 (1.30-2.82)
2-hr	0.538 (0.451-0.648)	0.698 (0.585-0.843)	0.916 (0.765-1.11)	1.10 (0.910-1.34)	1.36 (1.09-1.72)	1.57 (1.22-2.02)	1.78 (1.36-2.36)	2.01 (1.49-2.75)	2.33 (1.65-3.33)	2.59 (1.77-3.84)
3-hr	0.672 (0.563-0.810)	0.865 (0.724-1.04)	1.13 (0.940-1.36)	1.35 (1.11-1.64)	1.65 (1.32-2.09)	1.90 (1.48-2.45)	2.15 (1.64-2.86)	2.42 (1.79-3.31)	2.80 (1.98-4.00)	3.10 (2.12-4.60)
6-hr	0.967 (0.811-1.17)	1.25 (1.05-1.51)	1.64 (1.37-1.98)	1.95 (1.62-2.38)	2.39 (1.91-3.02)	2.73 (2.13-3.53)	3.08 (2.35-4.09)	3.45 (2.55-4.72)	3.96 (2.80-5.66)	4.37 (2.98-6.47)
12-hr	1.25 (1.05-1.51)	1.72 (1.44-2.07)	2.31 (1.93-2.80)	2.79 (2.31-3.41)	3.43 (2.74-4.34)	3.91 (3.06-5.06)	4.40 (3.35-5.83)	4.88 (3.61-6.68)	5.53 (3.91-7.90)	6.03 (4.11-8.93)
24-hr	1.64 (1.45-1.90)	2.44 (2.16-2.82)	3.44 (3.03-3.98)	4.22 (3.69-4.93)	5.23 (4.42-6.30)	5.97 (4.95-7.34)	6.69 (5.42-8.43)	7.40 (5.84-9.58)	8.33 (6.31-11.2)	9.02 (6.61-12.6)
2-day	1.96 (1.73-2.26)	3.04 (2.68-3.51)	4.39 (3.86-5.08)	5.44 (4.75-6.35)	6.81 (5.76-8.21)	7.82 (6.48-9.62)	8.80 (7.13-11.1)	9.78 (7.71-12.7)	11.0 (8.37-14.9)	12.0 (8.79-16.7)
3-day	2.14 (1.89-2.47)	3.37 (2.98-3.89)	4.92 (4.33-5.70)	6.14 (5.37-7.18)	7.74 (6.55-9.34)	8.93 (7.41-11.0)	10.1 (8.18-12.7)	11.3 (8.88-14.6)	12.8 (9.69-17.2)	13.9 (10.2-19.4)
4-day	2.31 (2.04-2.67)	3.67 (3.24-4.24)	5.39 (4.75-6.25)	6.76 (5.91-7.89)	8.56 (7.25-10.3)	9.91 (8.22-12.2)	11.3 (9.12-14.2)	12.6 (9.93-16.3)	14.4 (10.9-19.4)	15.7 (11.5-21.9)
7-day	2.63 (2.33-3.04)	4.14 (3.66-4.79)	6.12 (5.39-7.09)	7.72 (6.75-9.02)	9.89 (8.37-11.9)	11.6 (9.58-14.2)	13.2 (10.7-16.7)	15.0 (11.8-19.4)	17.3 (13.1-23.3)	19.1 (14.0-26.6)
10-day	2.78 (2.46-3.21)	4.35 (3.84-5.02)	6.43 (5.66-7.45)	8.14 (7.12-9.51)	10.5 (8.90-12.7)	12.4 (10.3-15.2)	14.3 (11.6-18.0)	16.2 (12.8-21.0)	19.0 (14.4-25.6)	21.1 (15.5-29.4)
20-day	3.33 (2.95-3.85)	5.13 (4.53-5.92)	7.59 (6.68-8.79)	9.69 (8.47-11.3)	12.7 (10.7-15.3)	15.1 (12.5-18.6)	17.6 (14.3-22.2)	20.4 (16.1-26.4)	24.3 (18.4-32.7)	27.5 (20.1-38.2)
30-day	3.94 (3.49-4.55)	5.95 (5.26-6.88)	8.78 (7.73-10.2)	11.2 (9.81-13.1)	14.8 (12.5-17.8)	17.7 (14.7-21.8)	20.9 (16.9-26.3)	24.3 (19.2-31.4)	29.3 (22.2-39.4)	33.4 (24.5-46.5)
45-day	4.64 (4.10-5.36)	6.82 (6.02-7.88)	9.93 (8.74-11.5)	12.7 (11.1-14.8)	16.8 (14.2-20.2)	20.2 (16.7-24.8)	23.9 (19.4-30.1)	28.1 (22.1-36.3)	34.2 (25.9-46.1)	39.4 (28.9-54.8)
60-day	5.39 (4.76-6.22)	7.70 (6.80-8.90)	11.1 (9.74-12.8)	14.1 (12.3-16.4)	18.6 (15.7-22.4)	22.4 (18.6-27.6)	26.7 (21.6-33.6)	31.5 (24.8-40.7)	38.6 (29.2-52.0)	44.7 (32.8-62.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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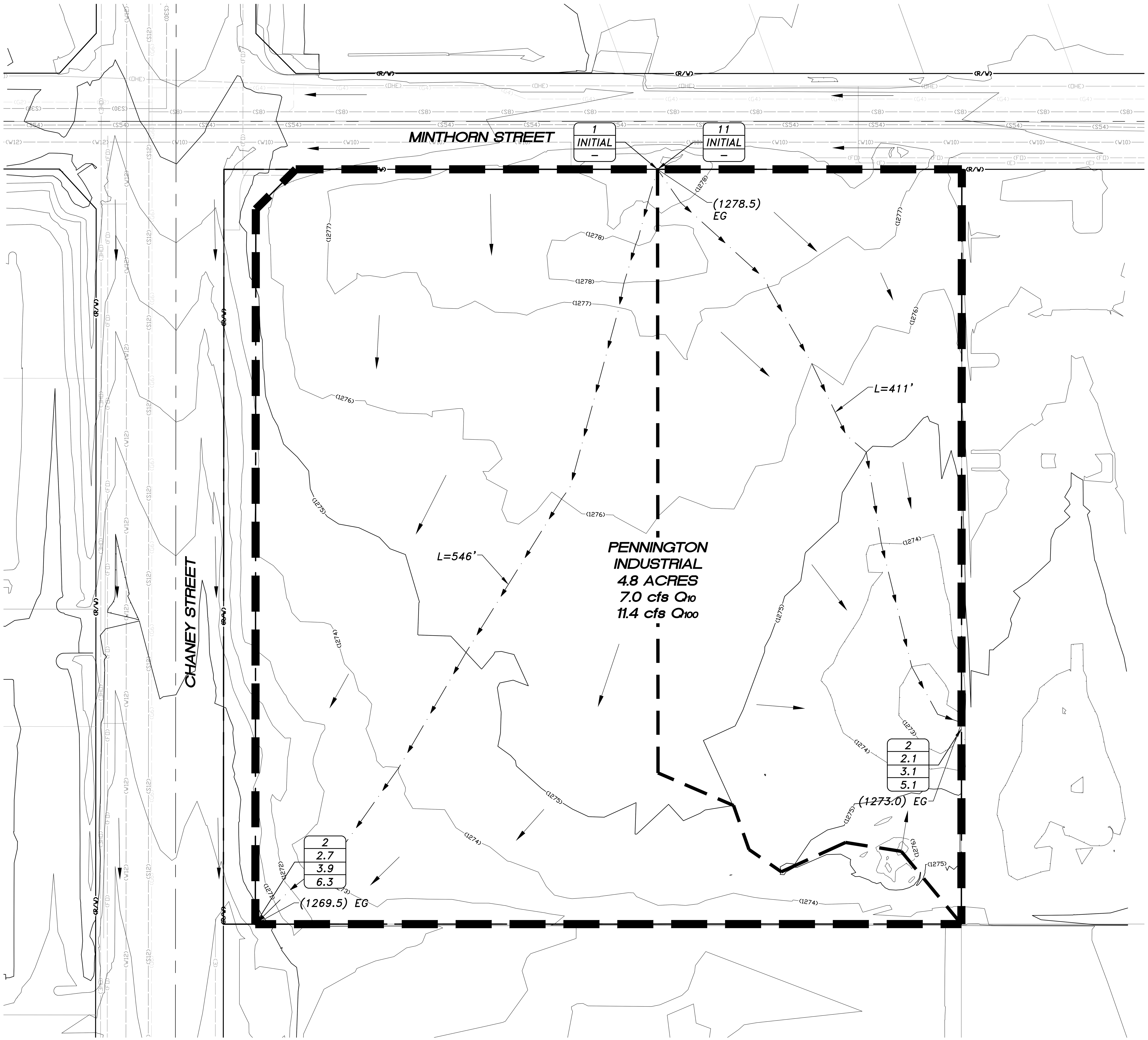
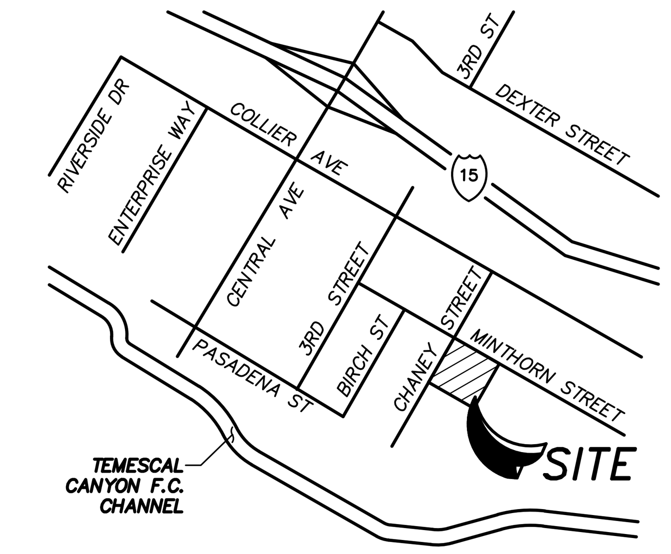
PF graphical

APPENDIX

C

HYDRAULIC CALCULATIONS (TO BE PROVIDED IN FINAL REPORT)





VICINITY MAP
THOMAS BROS. PAGE 866
GRID D3

APN

377-160-014

OWNER

PENNINGTON INDUSTRIAL LLC
c/o TOLD CORPORATION, MANAGER
621 VIA ALONDRA, SUITE 602
CAMARILLO, CA 93012
ATTN: ROD OSHITA
PHONE: 370-939-7102

LEGEND

- PROJECT BOUNDARY
- DRAINAGE SUB AREA BOUNDARY
- DIRECTION OF SURFACE DRAINAGE
- HYDRAULIC FLOW LENGTH
- 2 — RATIONAL METHOD NODE NUMBER
- 2.1 — AREA IN ACRES TRIBUTARY TO NODE
- 3.1 — 10-YR FLOW AT NODE IN CFS
- 5.1 — 100-YR FLOW AT NODE IN CFS

GRAPHIC SCALE
30' 0 30' 60' 90'

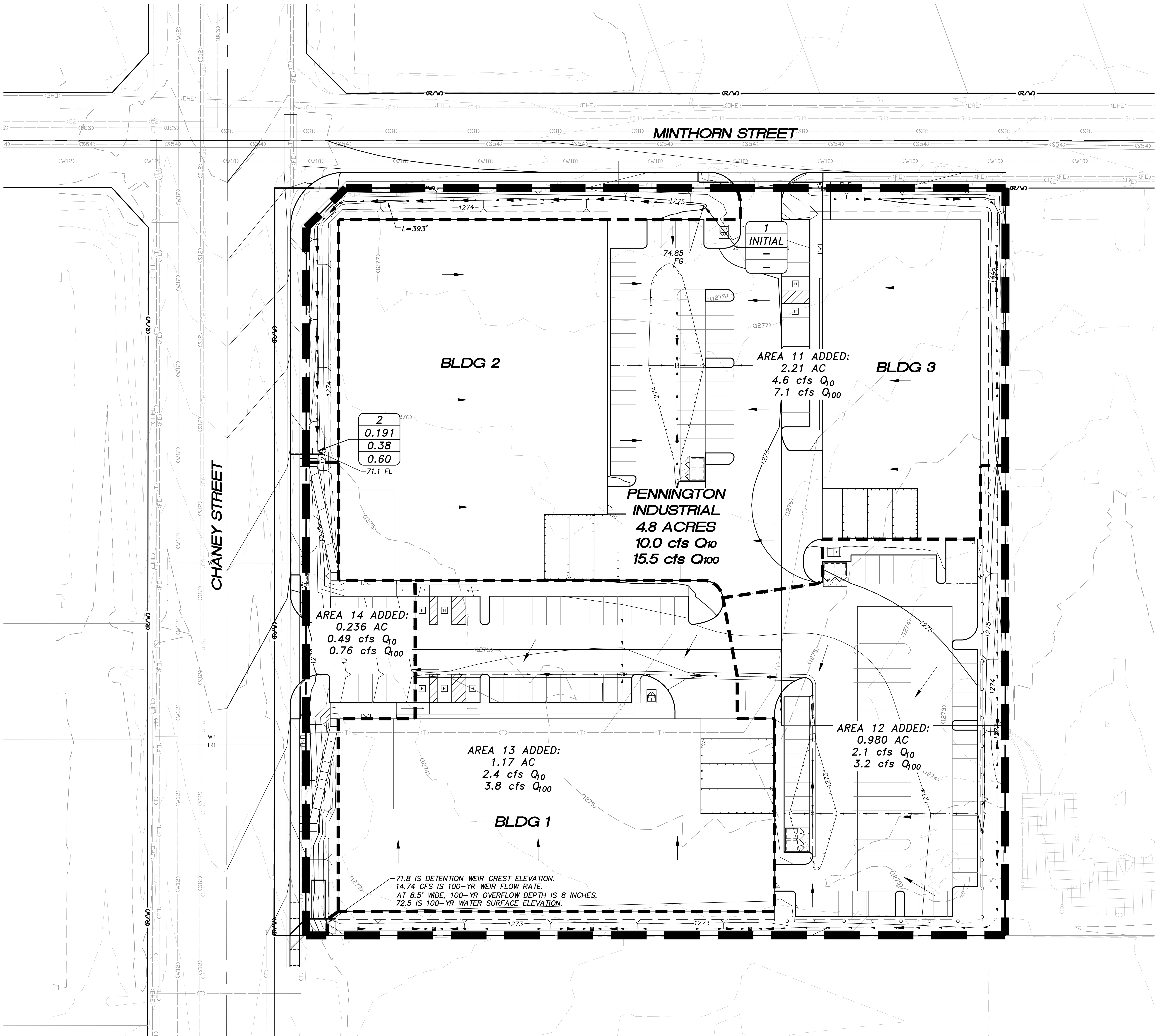
SB&O INC.
PLANNING ENGINEERING SURVEYING
3990 Ruffin Road, Suite 120
San Diego, Ca. 92123
858-560-1141
858-560-8157 Fax

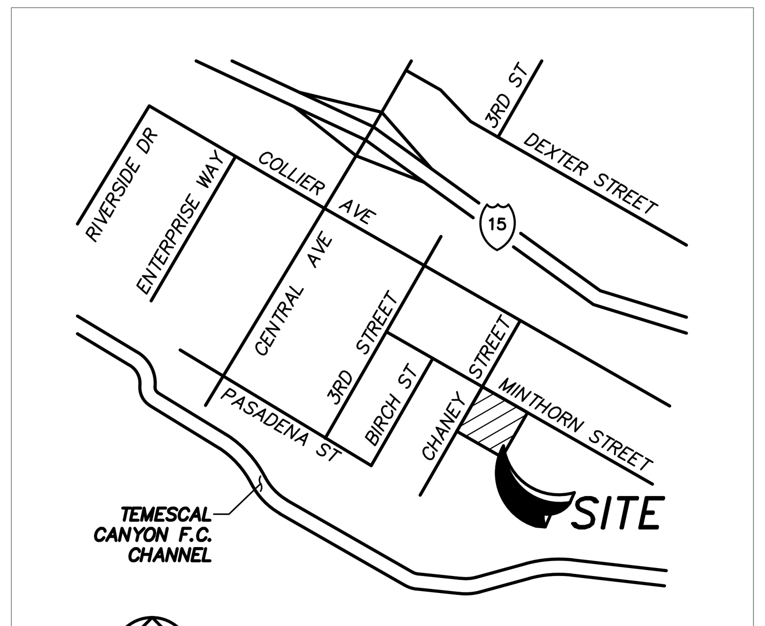
EXISTING DRAINAGE MAP PENNINGTON INDUSTRIAL PARK

SHEET 1 OF 1

2-27-2019 | 74420.25

I:\74422 Pennington Industrial\Dwg\Z-74422-zDM-EX.dwg





VICINITY MAP
THOMAS BROS. PAGE 866
GRID D3

APN
377-160-014

OWNER
FAIRWAY COMMERCIAL PARTNERS INC.
1601 N. SUPELVEDA BLVD. #401
MANHATTAN BEACH, CA 90266
PHONE: (310) 939-7102
CONTACT: ROD K. OSHITA

LEGEND

- PROJECT BOUNDARY
- INITIAL DRAINAGE AREA BOUNDARY
- AREA ADDED BOUNDARY
- DIRECTION OF SURFACE DRAINAGE
- INITIAL HYDRAULIC FLOW PATH

5	-RATIONAL METHOD NODE NUMBER
1.91	-AREA, ACRES, TRIBUTARY TO NODE
3.7	-10-YR FLOW, CFS
5.4	-100-YR FLOW, CFS

SCALE: 1" = 30'

GRAPHIC SCALE
30' 0 30' 60' 90'

SB&O INC.
PLANNING ENGINEERING SURVEYING
3990 Ruffin Road, Suite 120
San Diego, Ca. 92123
858-560-1141
858-560-8157 Fax

PROPOSED DRAINAGE MAP

PENNINGTON INDUSTRIAL

SHEET 1 OF 1

PRELIMINARY 5/10/2019 74420.65

I:\74422 Pennington Industrial\Dwg\Z-74422-zDM.dwg